National Institute of Environmental Health Sciences

Enhanced spatial models for predicting the geographic distributions of tick-borne pathogens

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Abstract:

BACKGROUND: Disease maps are used increasingly in the health sciences, with applications ranging from the diagnosis of individual cases to regional and global assessments of public health. However, data on the distributions of emerging infectious diseases are often available from only a limited number of samples. We compared several spatial modelling approaches for predicting the geographic distributions of two tick-borne pathogens: Ehrlichia chaffeensis, the causative agent of human monocytotropic ehrlichiosis, and Anaplasma phagocytophilum, the causative agent of human granulocytotropic anaplasmosis. These approaches extended environmental modelling based on logistic regression by incorporating both spatial autocorrelation (the tendency for pathogen distributions to be clustered in space) and spatial heterogeneity (the potential for environmental relationships to vary spatially). RESULTS: Incorporating either spatial autocorrelation or spatial heterogeneity resulted in substantial improvements over the standard logistic regression model. For E. chaffeensis, which was common within the boundaries of its geographic range and had a highly clustered distribution, the model based only on spatial autocorrelation was most accurate. For A. phagocytophilum, which has a more complex zoonotic cycle and a comparatively weak spatial pattern, the model that incorporated both spatial autocorrelation and spatially heterogeneous relationships with environmental variables was most accurate. CONCLUSION: Spatial autocorrelation can improve the accuracy of predictive disease risk models by incorporating spatial patterns as a proxy for unmeasured environmental variables and spatial processes. Spatial heterogeneity can also improve prediction accuracy by accounting for unique ecological conditions in different regions that affect the relative importance of environmental drivers on disease risk.

Source: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2373776

Resource Description

Early Warning System: ☑

resource focus on systems used to warn populations of high temperatures, extreme weather, or other elements of climate change to prevent harm to health

A focus of content

Exposure : ☑

weather or climate related pathway by which climate change affects health

Ecosystem Changes, Meteorological Factors, Precipitation, Temperature

Temperature: Fluctuations

Geographic Feature: ☑

resource focuses on specific type of geography

None or Unspecified

Geographic Location: ☑

resource focuses on specific location

United States

Health Impact: ☑

specification of health effect or disease related to climate change exposure

Infectious Disease

Infectious Disease: Vectorborne Disease

Vectorborne Disease: Tick-borne Disease

Tick-borne Disease: Anaplasmosis, Ehrlichiosis

Mitigation/Adaptation: ☑

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology: ☑

type of model used or methodology development is a focus of resource

Exposure Change Prediction

Resource Type: ☑

format or standard characteristic of resource

Research Article

Timescale: ☑

time period studied

Short-Term (

Vulnerability/Impact Assessment: ☑

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content